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Research Article

Potency of Wild Boar as Plant Pests in South Sulawesi

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ABSTRACT

Land damage and the risk of crop failure caused by wild boar (*Sus scrofa*) is one of the main challenge in agriculture. Wild boars often attack agricultural crops before harvest, such as corn field in several areas in Sulawesi which results in yield loss. Management of this pest must be done quickly and precisely to protect agricultural produce. This study aims to determine the potential of wild boar as a plant pest, especially on agricultural land in South Sulawesi. The research was conducted in Mamasa, Bulukumba, and Bantaeng, South Sulawesi Province. Quantitative and qualitative methods were applied to obtain primary data by direct interviewing 63 respondents. Respondents were farmers who experienced economic loss due to wild boar attacks on their crops. Meanwhile, secondary data were obtained from relevant references. Results showed that the wild boar in South Sulawesi is a potential crop pest in certain areas, including mountain (62%), swamp (38%) but not at bushland (0%). Corn was most the most severely damaged crop (70%) and the other damaged crops were cassava (11%), eggplant (6%), soybean (5%), tomato (3%), groundnut (3%), and sweet potato (2%). In order to reduce the pest risk, hence, extension programs to educate the farmer community are required.

Keywords: agricultural crops; crop damage; human-wild boar conflict; pest animals; pest control

INTRODUCTION

The emergence of various threats such as pests must be resolved by farmers. Pests are destructive animals on crops that cause economic loss to plants while some are vectors of virus diseases (Octaviana & Ekawati, 2022; Sari *et al*., 2021).

One of pests that is often troubling and cause crop failure is the wild boar. A wild boar in its food-seeking activities will preferentially target plantation crops, resulting in potential damage and losses (Cappa *et al*., 2021). This pest will sometimes start attacking farmlands when entering the harvest period. It also causes damage and results in losses for farmers. Wild boar (*Sus scrofa*) is often referred to as a pest species and is a type of hoofed animal, which has a very wide distribution and has a fairly high adaptability (Khattak *et al*., 2022).

The spread of wild boar pests in Sulawesi is expanding. Wild boar attacks do not only focus on crops but are also start to enter and threat local settlements. Pests often enter several residential areas in the Sulawesi region. The Department of Agriculture and Horticultural Crops admitted to being overwhelmed by the high number and presence of wild boars in North Sulawesi. Wild boars have been reported to destroy hundreds of corn and sweet potato plantations that were ready to be harvested (Luthfi, 2011). In remote areas, wild boar attacks have become so severe that farmers are no longer able to control them (Johann *et al*., 2020). Farmer's gardens that have been tended for months have been destroyed and devoured by wild boars in just one night (Daniel, 2012).

In addition, the wild boar's population continues to experience a high numbers, resulting in eco-

nomic losses (damage to crops and gardens). Crops that are often targeted by wild boars include corn, tubers, and vegetables. However, some studies have shown that wild boars prefer maize over other crops (Herrero *et al*., 2006). While government assistance through the agriculture office is mostly in the form of food crops, one of which is corn seeds, other crops often experience less attention. Approximately 400 plant species were identified and included in the wild boar food list, of which 40 were agricultural crops (Chauhan, 1999). Agricultural land is an illustration of the impacts caused by wild boars such as damaging to orchards, nurseries, forests, and grasslands. Crop damage caused by wild boars occur at various stages from seedlings to mature plants, all demonstrating great challenges for farmers (Wang *et al*., 2023).

Currently, community wild boar eradication efforts, such as hunting or making traditional traps, in Sulawesi are no longer effective to manage wild boar populations. Various tools and methods ranging from traditional to modern ones are used to reduce the impact of wild boar pests in damaging crops and the consequences from the method of choice should be considered (St Fatmawaty & Bijaksana, 2023). Government and the private sector are expected to contribute to managing wild boar. Recently, scientists in collaboration with wildlife managers have attempted to explore effective solutions to reduce wild boar crop damage.

Wild boars often attack agricultural crops at harvest time, such as corn in several areas in South Sulawesi. Control of this pest must be done quickly and precisely to create a conducive agricultural environment by implementing combination of sanitation standards, technical culture, mechanical, biological, or chemical management strategies. Mechanical control can be done by preventing wild boar from entering crop area using fences, deep ditches, or by hunting them.

Studies on the presence of wild boar in South Sulawesi are still very rare, more specifically studies that discuss the potential damage to crops. This study aims to study the potential of wild boar as a crop pests and control efforts from farmers to reducing wild boar attacks, especially in agricultural land in South Sulawesi.

MATERIALS AND METHODS

The research was conducted in several regions in South Sulawesi over 6 months, to study wild boar pest status. The farmers density who have plantation around the mountain foot and was affected by wild boar pests in Mamasa, Bulukumba, and Bantaeng were 347 farmers, while the sample is the number of farmers selected based on the Slovin formula as many as 63 farmers. The Slovin formula used was as the following (Santoso, 2023):

$$n = \frac{N}{1 + N(e)^2}$$

Description: n = sample size; N = population size; e = error level, generally used 1% (0.01), 5% (0.05), and 10% (0.1).

Primary and secondary data was obtained by these means:

1. Primary data was obtained directly from the field by conducting direct observations to the location and interviews with respondents comprising of various aspects, such as land characteristics, cultivated crop commodities, types of crops damaged by wild boar, status of land damaged by wild boar whether it is still cultivated or not, time and system of wild boar arrival, wild boar area of origin, behavior of wild boar when attacking crops, and what equipment is used to repel wild boar pests. Wild boar attacks intensity on agricultural land in South Sulawesi was observed and since wild boars damage on corn plants are absolute type of damage because they attack stems and cobs preventing plants to produce maximum yields (*Direktorat Perlindungan Tanaman Pangan*, 2018), the applicable formula was:

$$I = \frac{n}{N} \times 100\%$$

Description: I = Attack intensity (%); n = Number of plant samples or specific plants (leaves, shoots, flowers, fruits, buds, plants, clumps of plants) that are absolutely damaged or considered to be absolutely damaged; N = Number of sample plants or plant parts observed.

2. Secondary data, obtained by studying, reviewing, and analyzing books, journals, from previous research, documents, regulations and references that are closely related to the problem being studied.

RESULTS AND DISCUSSION

To ensure representativeness results of this study to potential wild boars crop damage in South Sulawesi, an adequate sample size must first be determined, and the use of Slovin's resulted in 63 farmers to be sampled and achieve a margin of error of 10%. In South Sulawesi, wild boars are present as an endemic subspecies of *S. scrofa celebensis* (Brumm, 2023). Today, wild boars are wide-spread throughout the island even all over the world (Figure 1). Terrestrial environments areas colored white indicates low density, orange indicates medium density, and dark red indicates high density. Results showed that wild boar inhabitated Sulawesi where they occupy a variety of habitats including forests, lowland cultivated land, grasslands, and cultivated areas. Despite the abundance and widespread distribution of wild boar, very few studies analyze their negative impacts on human activities and biodiversity.

Wild boar is a wild animal that lives in the forest and threat agricultural fields, especially in rural areas in South Sulawesi, especially in Mamasa, Bulukumba and Bantaeng Districts. Areas that are often attacked by wild boars are agricultural areas located close to the forest. Geographically South Sulawesi Province is located between 0°12' to 8°00' south latitude and 116°48' to 122°36' east longitude, with an area of 45,764.53 km^2. The climate of South Sulawesi is wet tropical. The climatic condition of this region, include: average air temperature of 26.8 °C, average air humidity of 81.9%, average rainfall of 289 mm^3, average of 159 days of rain per year, wind speed of 4 knots, and air pressure of 1011 mb. Areas that experience wild boar damage are Bulukumba Regency, especially in Anrihua Village, Kindang District; Bantaeng District, Biangloe Village, Pajukukang Sub-district; Mamasa District, Mehalaan and Botteng Villages, Mehalaan Sub-district.

Wild Boar Habitat

Wild boars are widely distributed across Indonesian and can survive in different habitat, ranging from desert areas, grasslands, temperate forests, or tropical forests and are considered one of the world's

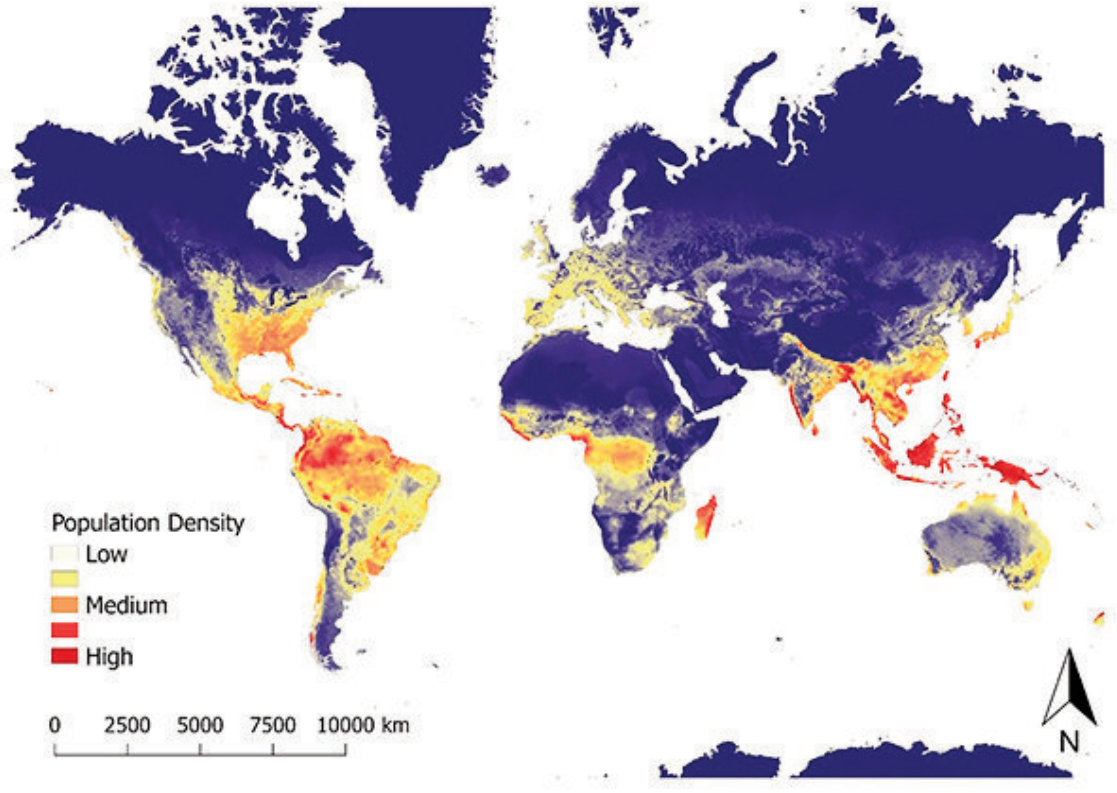

Figure 1. Map of predicted population density of wild boars for habitat occurring across the world, source image: Lewis *et al.* (2017)

most dangerous invasive species due to their extensive ecosystem disruption and agricultural damage (Lewis *et al.*, 2017). Wild boars adapt to the availability of their food sources. Wild boars generally live in dense, food-diverse forests. Large populations of wild boar have become a problem because of their role as pests in agricultural land and their habit of destroying soil while searching for food. In some areas of Sulawesi, wild boar habitats are more likely to be mountainous, based on data collected from residents from this study..

As much as 62% of respondents around the location stated that wild boars come from the mountain (Figure 2). People assume that wild boars will come down from the mountain to search for food and target their farmlands. Wild boar food searching habits can be influenced by environmental factors (Risch *et al.*, 2022). In South Sulawesi, wild boar emergence will increase in some highland areas during the rainy seasons and distance to the nearest forest and vegetation density facilitate wild boar in entering plantations.

Wild boars generally like to live near mud puddles - shallow, muddy pools of water. This wallowing is an important routine, helping to eliminate parasites, regulating body temperature heat and protect sensitive skin from harmful sunrays (Albert *et al.*, 2014). After wallowing, wild boars will usually use bushes to clean mud and ectoparasites stuck to their bodies. Apart from the wallowing, other factors that cause wild boars to appear are (Morais *et al.*, 2019), such as: (1) wild boars can change their habitat easily throughout the year, even in tropical environments like Indonesia; (2) wild boars favor areas with dense forests where fruit trees are abundant; (3) seasonal conditions are the main factor affecting for wild boars movement; (4) distance between the forest and the land is quite close.

Damage to Plants

Wild boar can cause of significant crop losses and failures compared to other animals due to their omnivorous behavior and ability to live in many habitat types (Sarwar, 2019). Communities that depend on agricultural products as their main source of income can lose 10−15% or more to wildlife such as wild boar (Lamarque *et al.*, 2009). This risk clearly shows that wild boars are one of the pests that require special attention in agriculture.

Many areas in Sulawesi are cultivated with food crops and plantation crops such as rice, corn, soybeans, peanuts, cassava, cloves, and vegetables such as tomatoes and eggplants. However, not all crops planted are attacked by wild boars. Commodities damaged by wild boars include corn (70%), followed by cassava (7%), eggplants (4%), soybeans (3%), peanuts (2%), tomatoes (2%), and sweet potatoes (1%) (Figure 3). Based on interviews conducted with farmers, this type of commodity is the most frequently attacked by wild boars, while no

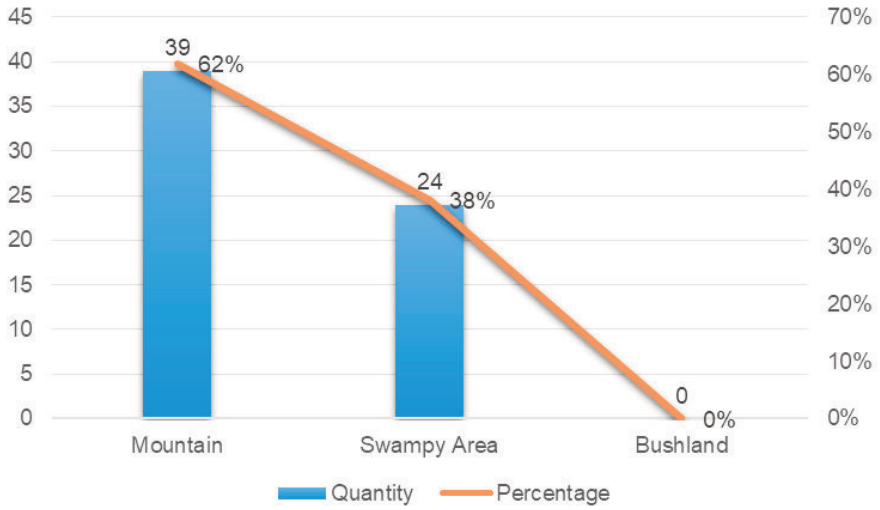

Figure 2. Percentage of wild boar presence at three habitat types in South Sulawesi (source: primary data analysis, 2023)

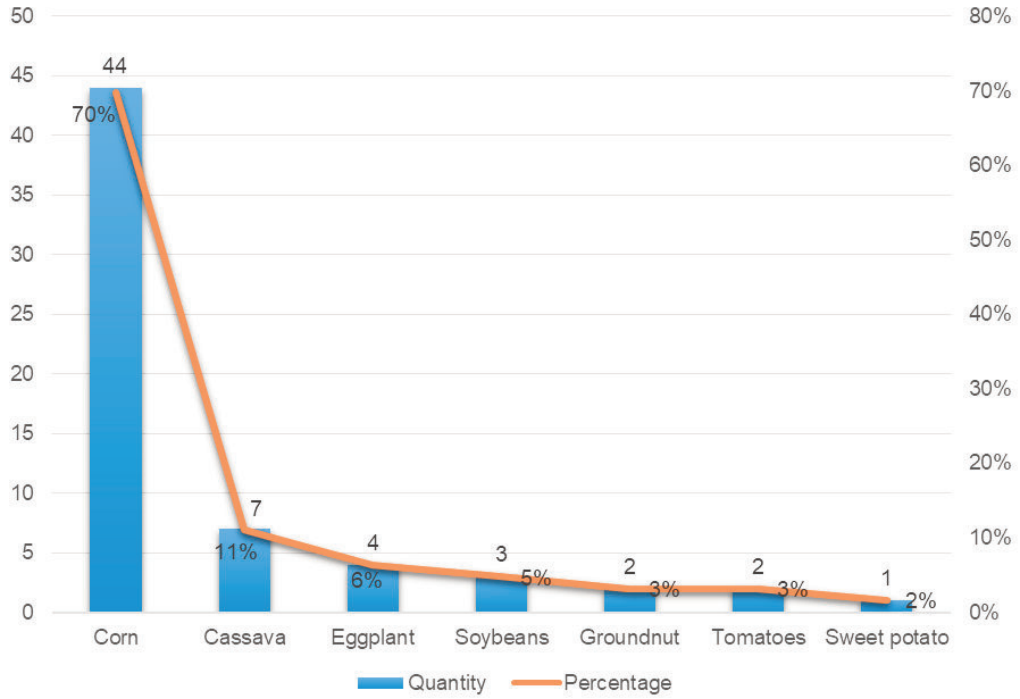

Figure 3. Percentage of damaged commodities caused by wild boar attacks in South Sulawesi (source: primary data analysis, 2023)

Table 1. Location, habitat type and land under threat from wild boars

No.	Location	Habitat Type	Land under threat
1	Mamasa	Tropical rainforests, mountains, and wetland	Corn plantation
2	Anrihua	Forest areas where there are streams, water sources, swamps, and water holes that allow drinking water to be obtained and connected.	Cassava and sweet potato plantations
3	Biangloe	Lowland rainforest and swamp	Vegetable and Corn Plantation

damage has occurred to rice plants in research locations. The high rate of damage to corn plants requires further observation related to the intensity of damage that occurs, from a total of 3 locations in South Sulawesi, there were two locations that cultivate corn, namely Biangloe Village in Bantaeng Regency, Mehalaan Village and Botteng Village in Mamasa Regency (Table 1). As much as 60 corn plants were sampled. The wild boar infestation that occurred in the three locations showed variations in the level and intensity of infestation. Wild boar infestation in South Sulawesi showed differences damage intensity among three villages that were observed. The highest damage intensity was shown in Mehalaan Village (72%), followed by Botteng Village (35%) and the lowest is in Biangloe Village (25%) (Table 2). There are two villages that have damage intensity values that fall into the medium damage category, namely Biangloe Village and Botteng Village, while Mehalaan Village experienced heavy damage.

Meanwhile, plant parts damaged by wild boar pests include rootstocks, leaves, and fruits of highly favored plants (Table 3). In corn productions, wild boars can damage corn rootstock, leaves, and cob. In tuber crops, such as cassava and sweet potato, wild boar can damage rootstock, leaves, and tubers, while in soybean and peanut, the damaged parts of the plant are almost the entire rootstock, scion, branches, leaves, and seeds. Tomatoes and eggplants

Table 2. Infestation intensity of wild boar in three plantation areas in South Sulawesi

Location	Total Plants Sampled	Number of Affected Sample Plants	Attack Rate
Biangloe	60	17	27%
Botteng	60	22	37%
Mehalaan	60	43	72%
Average in one stretch	60	27	45%

can potentially be damaged although not severe. Figure 4 shows maize plantation before and after damaged by wild boars, before the arrival of wild boars, and farmland conditions in Mehalaan Village.

Table 3. Plant parts of various commodities damaged by wild boars

Commodities	Damaged Plant Parts
Corn	Rootstock, leaf, fruit
Cassava	Rootstock, Fruit
Soybeans	Rootstock, scion, branch, leaf, seed
Tomatoes	Rootstock, scion, branch, leaf, fruit
Groundnut	Rootstock, scion, branch, leaf, seed
Eggplant	Rootstock, scion, branch, leaf, fruit
Sweet Potato	Stem, leaf, fruit

Significant damage occurred and worsened after the arrival of wild boars to maize farms in search of food, resulting in most farmers experiencing crop failure.

Damage type is the form of damage on plant parts due to wild boars food-seeking activities or triggered aggressive behavior. These various damage types in people's plantations include ruffling, attacking plant growth points, broken stems, injured tubers or fruits, damaged leaves, and damaged seeds (Table 4).

Based on information obtained from farmers, wild boars attack at night and attack in groups usually carried out by groups of juvenile wild boar which are a combination of several brood stock or mother boar with their young. Wild boars enter people's farms through special routes used as both entry and exit routes. Wild boars not only attack food crops, but also plantation crops such as rubber, coconut, sugarcane, etc (Kulimba *et al.*, 2019), there is currently no information on damage caused by wild boar attacks on industrial plantation commodities in South Sulawesi. After the destruction, the wild boar will return to its habitat, nest, or forest for shelter.

Wild boars in Sulawesi have managed to enter settlements and attack local residents which troubling for communities (Febriady, 2022). Therefore, various efforts have been made to prevent wild boars from entering settlements, one of which is by planting plants that have a distinctive aroma to repel wild boars. The plants that are not favored by wild boar pests included artemisia, garlic, papaya, tagetes, and lemongrass. Although these plants have low economic value, farmers should plant them as they are more resistant to wild boar attacks. Likewise, industrial plants that are not favored by wild boar pests include patchouli plants, which have high economic value, but there has been no government assistance. Large capital is required to establish extensive patchouli planting and later patchouli oil distillation factories.

The losses wild boar infestation in Mamasa Regency, West Mehalaan Village and Botteng Village have been occuring for five years since the opening of the UPT Rano transmigration land in 2019 in West Mehalaan Village. As a result of forest clearance, the wild boars' habitat has been disrupted, causing them to come down from the mountain and damage corn crops and enter farmers' residential areas. Corn production ares in the West Mehalaan Subdistrict was 50 ha and outside UPT Rano, namely Botteng Village, was 50 ha. The loss in 5 years due to wild boar damage was approximately IDR 919, 800,000 assuming that the average national corn production is around 2 tons of dry shells/ha and maize price in South Sulawesi of IDR 4,599 per kg (SIJAGUNG, 2024).

Whereas in Bulukumba Regency, precisely in Anrihua Village, wild boar attacks have occurred

Figure 4. Corn field before wild boar attack (a); damage that occurred in corn plantations due to wild boar infestation (b) [photo by Nurnayanti, 2023]

since 2015 and are still ongoing until now. Wild boars damage only occur at night because farmers in the village have started their agricultural activities in the early morning until late afternoon. Wild boars have damaged an estimated 15 hectares of land in the village, causing losses to farmers, including those who cultivate tuber crops such as cassava and sweet potatoes. Biangloe Village in Bantaeng Regency also experienced the same thing, where wild boars are still a threat to farmers in the village. Most farmers in the village cultivate vegetable crops such as tomatoes, eggplants, chilies, and other tuber crops. Wild boar attacks began to occur around 2018 when the area of land destroyed could reach 16 ha. Until now, there has been no further effort to prevent the pest, remaining a threat to farmers.

Table 4. Feeding behaviour and the type of damage caused by wild boar on various cultivated commodities in South Sulawesi

Commodities	Damage Types	Attack Pattern
Corn	Broken stem	At random
Cassava	Tuber wound	Attacks the growing point of the plant
Soybeans	1. Damaged seeds 2. Damaged leaves 3. Broken stems	At random
Tomato	1. Fruit wound 2. Damaged leaves 3. Broken stems	At random
Groundnut	1. Damaged seeds 2. Damaged leaves 3. Broken stems	At random
Eggplant	1. Fruit wound 2. Damaged leaves 3. Broken stems	At random
Sweet Potato	Tuber wound	Digging up bulbs and at random

Wild Boar Pest Control

One of the challenges in the agriculture is the risk of crop failure posed by wild boars. To reduce and overcome the possibility of this risk, in their research Nurhazizah and Susilawati (2023) explained that the tradition of hunting wild boars (ciliang) is believed to be effective in controlling wild boar pests. There are several methods used in wild boar control efforts, such as sanitation, cultural, mechanical, biological and chemical control techniques (Andrian *et al.*, 2023). Mechanical control can be achieved by preventing wild boars from entering the plantation area, by:

(1) Building fences with strong foundations around the land. Based on interviews with respondent farmers, there are only seven farmers who apply this method using materials, such as wood, bamboo or used zinc, the type of zinc commonly

used by farmers is corrugated sheet because it is widely available in a variety of sizes (Figure 5).

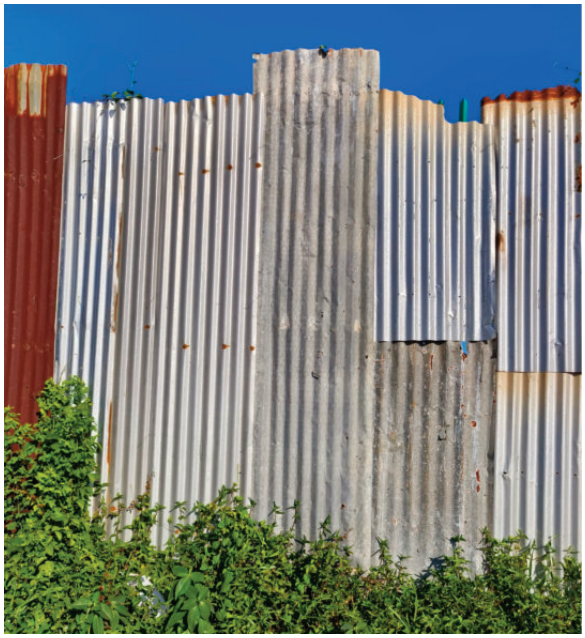

Figure 5. Zinc corrugated sheet used as fences [photo by Nurnayanti, 2023]

For farmers this fence is very suitable to be built around the land because the material is easy to find, environmentally friendly and does not need to spend money, however, the durability of this fence is not so long considering the basic materials used at any time are easily weathered.

(2) Building deep and wide ditch around the field.

(3) Capturing wild boars using several types of traps. Some farmers catch wild boar using traps in the form of holes dug 2 meters deep, where these holes will later be filled with dry leaves and twigs. Another type of trap is to attach a rope around plants that are often targeted by wild boars (Figure 6). Traditional control measures for controlling wild boar pest in Sulawesi used empty cans filled with gravels or other hard objects to produce noise sound, hanging white cloth around the land, poison baits, spears for hunting (Figure 7).

Sulawesi communities in their efforts to prevent damage to agricultural land more often use spears (43%) and cans (40%). Used cans filled with pebbles are hung around the farmland and will automatically make sound when the wind blows to repel wild boars due to their sensitivity to sound. Meanwhile, spears are also an effective tool used by 43% of farmers to repel wild boars. Spears used in wild boar hunting activities are usually made of iron with sharpened tips, farmers in Sulawesi usually hunt 2 times a month. The various types of poison baits are applied by 11% of farmers at around the land locations. In general, the types of poisons used to kill wild boars were zinc phospide and Temik (a.i), but due to the lack of knowledge and education of farmers in Mehalaan and Botteng regarding these poisons, they prefer to use a mixture of water and shellfish as natural wild boar poisons, the poison used is a concoction consisting of 1 kg of finely ground shells mixed with fresh water, this mixture is then applied to 1 kg of shredded wild cassava. Afterwards, the poison is stored in an old tin can for 3 days before being placed in a place frequented by wild boars. Farmers stated that the mixture of shells and water can cause digestive issue when consumed. Poison also needs to be administered repeatedly to paralyze the wild boar although no dead wild

Figure 6. Making trap holes for wild boar (a); wild boar snares (b) [photo by Nurnayanti, 2023]

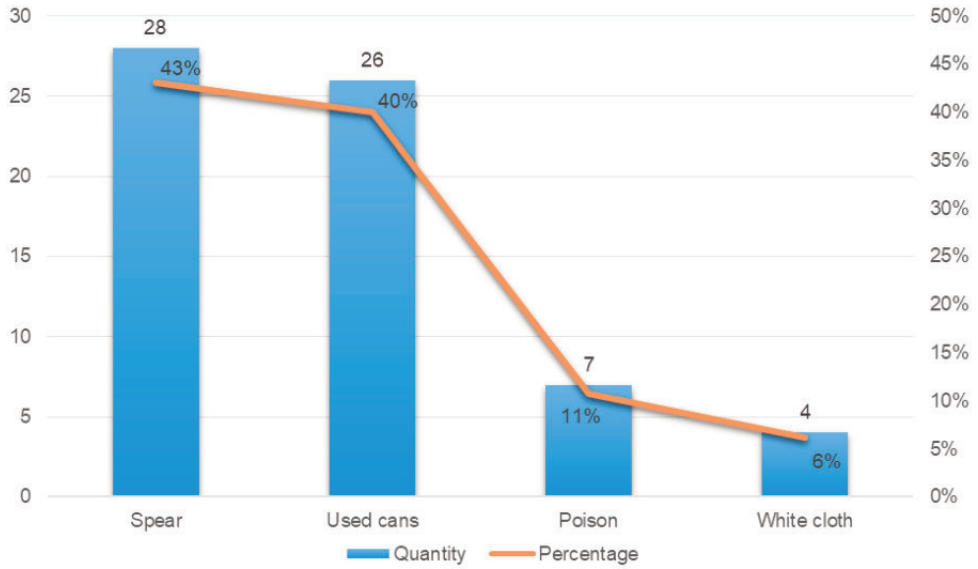

Figure 7. Control measures used for controlling wild boar in South Sulawesi (source: primary data analysis, 2023)

boars have been reported as a result of the poison. A tool that was least used by farmers (4%) was white clothes that hung on around the farm land at which the bright color can be directly seen by wild boars, farmers consider this method to have low success rate because damage to plantations were still found.

Tools modified with current technology is still rare. The application of modern technology on agricultural land to repel wild boar pests that can be integrated using a solar-powered, included electric fence system, IoT technology to monitor and guard the garden, where PIR sensors to monitor the movement of wild boars and speakers to repel wild boars.

CONCLUSION

Wild boar is considered an agricultural pest and a nuisance to residents. Incidents of the wild boar attacks occurring at some areas in South Sulawesi that result in significant loss. Corn was the most preferred and damaged crop by wild boar then followed by tuber and vegetable crops. Farmers endeavors to prevent wild boars entering their agricultural lands use several control measures, including empty cans to produce noise, spears for hunting wild boars, poison baits, and white clothes.

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